THE FOLLOWING ARE THE ENGLISH TRANSLATION OF ANNEXES TO THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (ARTICLE 34):

Amended Sheets (Pages 6, 6/1, 7, 7/1, 8, 8/1, 21, 22, 27, 27/1, 28, 28/1, 29, 30, 30/1, 30/2, 31, and 31/1)

Disclosure of Invention

The present invention has been made to solve the above problems, and has as its object to decrease reflection loss that occurs when the frequency of electromagnetic waves such as microwaves to be input to the distributor changes.

In order to achieve the above object, according to the present invention, there is provided a distributor characterized by comprising an oscillator which outputs electromagnetic waves, a first square waveguide to be connected to the oscillator, a second square waveguide having a plurality of openings, and a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to tube axes, wherein the first square waveguide and the second square waveguide communicate with each other through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide, the second square waveguide communicates with radiation waveguides through the openings, and the first square waveguide comprises a first guide wall which projects from the other narrow wall toward the communication hole and guides the electromagnetic waves propagating in the first square waveguide toward the communication hole.

According to the present invention, there is also provided a plasma processing system characterized

by comprising a stage to place a target object thereon, a processing vessel to accommodate the stage, an antenna assembly having a plurality of radiation waveguides with slots, and a distributor which distributes electromagnetic waves to the radiation waveguides, wherein the radiation waveguides are arrayed in a widthwise direction perpendicular to the tube axes with respect to the processing vessel, the distributor comprises an oscillator which outputs the electromagnetic waves, a first square waveguide to be connected to the oscillator, and a second square waveguide to be connected to one end of each of the radiation waveguides through a plurality of openings formed therein, the first square waveguide and the second square waveguide communicate with each other through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide, the first square waveguide comprises a first guide wall which projects from the other narrow wall toward the communication hole and guides the electromagnetic waves propagating in the first square waveguide toward the communication hole, and the second square waveguide a plurality of second guide walls which project from the one narrow wall toward each of the openings.

According to the present invention, there is also provided a distributing method characterized by comprising the first step of introducing electromagnetic waves propagating in a first square waveguide into a second square waveguide through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide, and the second step of distributing the electromagnetic waves introduced into the second square waveguide to a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to the tube axes, through a plurality of openings formed in the second square waveguide, wherein in the first step, the electromagnetic waves propagating in the first square waveguide are guided toward the communication hole by a guide wall which projects from the other narrow wall of the first square waveguide toward the communication hole.

According to the present invention, there is also provided a plasma processing method characterized by comprising the first step of introducing electromagnetic waves propagating in a first square waveguide into a second square waveguide through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide, the second step of distributing the electromagnetic waves introduced into the second square

waveguide to a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to the tube axes, through a plurality of openings formed in the second square waveguide, the third step of supplying the electromagnetic waves introduced into the radiation waveguides to a processing vessel through a slot formed in each of the radiation waveguides, and the fourth step of processing a target object placed in the processing vessel utilizing a plasma which is generated by the electromagnetic waves supplied to the processing vessel, wherein in the first step, the electromagnetic waves propagating in the first square waveguide are guided toward the communication hole by a first guide wall which projects from the other narrow wall of the first square waveguide toward the communication hole, and in the second step, the electromagnetic waves propagating in the second square waveguide are guided toward the opening by a plurality of second guide walls which project from the one narrow wall of the second square waveguide toward each of the openings.

According to the present invention, there is also provided a process for fabricating an LCD, characterized by comprising the first step of introducing electromagnetic waves propagating in a first square waveguide into a second square waveguide through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide, the second step of distributing the electromagnetic waves introduced into the second square waveguide to a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to the tube axes, through a plurality of openings formed in the second square waveguide, the third step of supplying the electromagnetic waves introduced into the radiation waveguides to a processing vessel through a slot formed in each of the radiation waveguides, and the fourth step of subjecting a surface of an LCD substrate arranged in the processing vessel to a process such as etching, ashing, oxidation, nitridation, or CVD utilizing a plasma which is generated by the electromagnetic waves supplied to the processing vessel, wherein in the first step, the electromagnetic waves propagating in the first square waveguide are guided toward the communication hole by a first guide wall which projects from the other narrow wall of the first square waveguide toward the communication hole, and in the second step, the electromagnetic waves propagating in the second square

waveguide are guided toward the opening by a plurality of second guide walls which project from the one narrow wall of the second square waveguide toward each of the openings.

is set to a value between the relative dielectric constant of the region away from the communication hole 32 and that in the feeding waveguide 41, a change in relative dielectric constant at the connecting portion of the two waveguides 31 and 41 can be moderated, so the band narrowing of the frequency that can pass through the connecting portion can be suppressed. As a result, power that cannot pass through the connecting portion but is reflected when the microwave frequency changes can be decreased, so the reflection loss of a microwave distributor 30B can be decreased.

Alternatively, three or more types of wave delaying members may be employed, so the relative dielectric constant in the microwave waveguide 36 and feeding waveguide 41 changes with three levels or more.

Fourth Embodiment

Fig. 8 is a cross-sectional view showing the arrangement of a microwave supply device according to the fourth embodiment of the present invention. This microwave supply device 13 is formed by combining a plurality of microwave supply devices 11 according to the second embodiment, and comprises a plurality of microwave oscillators 20. More specifically, the microwave supply device 13 comprises eight microwave supply devices 11A, 11B, 11C, 11D, 11E, 11F, 11G, and 11H, and eight microwave oscillators 20. The microwave supply devices 11A to 11H are arranged such that their

surfaces (wide walls of the radiation waveguides 51A to 51F) where radiation slots 52 of respective antenna assemblies 50 are formed form one flat surface. In the example shown in Fig. 8, the microwave supply devices 11A to 11D are arranged such that side walls 64 and 66 of their antenna assemblies 50 oppose each other. This also applies to the microwave supply devices 11E to 11H. The microwave supply devices 11A and 11E are arranged such that side walls 65 of their antenna assemblies 50 oppose each other. This also applies to the microwave supply devices 11B and 11F, 11C and 11G, and 11D and 11H.

As in this embodiment, when power is supplied into the processing vessel 1 using the plurality of microwave supply devices 11A to 11H, power supply equivalent to that achieved by using a single high-output oscillator can be realized using a plurality of low-output oscillators. That is, even when high power must be supplied to the processing vessel 1, as in a case of performing a plasma process using a large-diameter processing vessel 1, if a plurality of microwave oscillators 20 are arranged, low-output oscillators serving as the microwave oscillators 20 can be employed. Since the manufacturing cost of the low-output oscillator is low, the manufacturing cost of the entire plasma processing system can be decreased.

In this embodiment, the plurality of microwave supply devices 11 according to the second embodiment are

C L A I M S

1. (amended) A distributor characterized by comprising:

an oscillator which outputs electromagnetic waves;

a first square waveguide to be connected to said oscillator;

a second square waveguide having a plurality of openings; and

a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to tube axes,

wherein said first square waveguide and said second square waveguide communicate with each other through a communication hole formed in one narrow wall of each of said first square waveguide and said second square waveguide,

said second square waveguide communicates with radiation waveguides through the openings, and

said first square waveguide comprises a first guide wall which projects from the other narrow wall toward the communication hole and guides the electromagnetic waves propagating in said first square waveguide toward the communication hole.

2. (amended) A distributor according to claim 1, characterized in that said second square waveguide comprises a plurality of second guide walls which project from said one narrow wall toward each of the

openings.

3. (amended) A distributor according to claim 2, characterized in that the electromagnetic waves which are reflected by said first guide wall and travel in an opposite direction in said square waveguide and the electromagnetic waves which are reflected by an end of said first square waveguide cancel each other.

4. (amended) A distributor according to claim 3, characterized in that

said first guide wall is arranged to oppose the communication hole, and

said end of said first square waveguide is arranged at a position away from said first guide wall by an integer multiple of substantially 1/2 a tube wavelength of said first square waveguide.

5. A distributor according to claim 1, characterized in that said second square waveguide comprises a conductive column which is arranged in the vicinity of the communication hole and extends between opposing wide walls.

6. (amended) A distributor according to claim 1, characterized in that said first square waveguide and said second square waveguide have different relative dielectric constants.

7. (amended) A plasma processing system characterized by comprising:

a stage to place a target object thereon;

a processing vessel to accommodate said stage;

an antenna assembly having a plurality of radiation waveguides with slots; and

a distributor which distributes electromagnetic waves to said radiation waveguides,

wherein said radiation waveguides are arrayed in a widthwise direction perpendicular to the tube axes with respect to said processing vessel,

said distributor comprises

an oscillator which outputs the electromagnetic waves,

a first square waveguide to be connected to said oscillator, and

a second square waveguide to be connected to one end of each of said radiation waveguides through a

plurality of openings formed therein,

said first square waveguide and said second square waveguide communicate with each other through a communication hole formed in one narrow wall of each of said first square waveguide and said second square waveguide,

said first square waveguide comprises a first guide wall which projects from the other narrow wall toward the communication hole and guides the electromagnetic waves propagating in said first square waveguide toward the communication hole, and

said second square waveguide a plurality of second guide walls which project from said one narrow wall toward each of the openings.

8. A plasma processing system according to claim 7, characterized in that each of said radiation waveguides has a standing wave driving slot, on the other end of a side wall thereof, to be driven by standing waves which are formed of traveling waves traveling from said one end toward said other end and reflected waves reflected by said other end toward said one end.

9. A plasma processing system according to claim 8, characterized in that said standing wave driving slot is formed at a position away from said other end toward said one end by a natural number multiple of substantially 1/2 a tube wavelength of a corresponding one of said radiation waveguides.

10. A plasma processing system according to claim 8, characterized in that each of said radiation waveguides comprises a reflecting member which is arranged on a side of said one end, when seen from said standing wave driving slot, and reflects part of the traveling waves toward said one end to cancel the reflected waves which are reflected by said other end or said standing wave driving slot.

11. A plasma processing system according to claim 10, characterized in that said reflecting member is arranged at a predetermined position between a center position of said standing wave driving slot and a position away from the center position toward said one end by substantially 3/2 the tube wavelength of said corresponding one of said radiation waveguides.

12. (amended) A distributing method characterized by comprising:

the first step of introducing electromagnetic waves propagating in a first square waveguide into a second square waveguide through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide; and

the second step of distributing the electromagnetic waves introduced into the second square waveguide to a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to the tube axes, through a plurality of openings formed in the second square waveguide,

wherein in the first step, the electromagnetic waves propagating in the first square waveguide are guided toward the communication hole by a guide wall which projects from the other narrow wall of the first square waveguide toward the communication hole.

13. (amended) A plasma processing method characterized by comprising:

the first step of introducing electromagnetic waves propagating in a first square waveguide into a second square waveguide through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide;

the second step of distributing the electromagnetic waves introduced into the second square waveguide to a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to the tube axes, through a plurality of openings formed in the second square waveguide;

the third step of supplying the electromagnetic waves introduced into the radiation waveguides to a processing vessel through a slot formed in each of the radiation waveguides; and

the fourth step of processing a target object placed in the processing vessel utilizing a plasma which is generated by the electromagnetic waves supplied to the processing vessel,

wherein in the first step, the electromagnetic waves propagating in the first square waveguide are guided toward the communication hole by a first guide wall which projects from the other narrow wall of the first square waveguide toward the communication hole, and

in the second step, the electromagnetic waves propagating in the second square waveguide are guided

toward the opening by a plurality of second guide walls which project from said one narrow wall of the second square waveguide toward each of the openings.

14. (amended) A process for fabricating an LCD, characterized by comprising:

the first step of introducing electromagnetic waves propagating in a first square waveguide into a second square waveguide through a communication hole formed in one narrow wall of each of the first square waveguide and the second square waveguide;

the second step of distributing the electromagnetic waves introduced into the second square waveguide to a plurality of radiation waveguides arrayed in a widthwise direction perpendicular to the tube axes, through a plurality of openings formed in the second square waveguide;

the third step of supplying the electromagnetic waves introduced into the radiation waveguides to a processing vessel through a slot formed in each of the radiation waveguides; and

the fourth step of subjecting a surface of an LCD substrate arranged in the processing vessel to a process such as etching, ashing, oxidation, nitridation, or CVD utilizing a plasma which is generated by the electromagnetic waves supplied to the processing vessel,

wherein in the first step, the electromagnetic waves propagating in the first square waveguide are guided toward the communication hole by a first guide wall which projects from the other narrow wall of the first square waveguide toward the

communication hole, and

in the second step, the electromagnetic waves propagating in the second square waveguide are guided toward the opening by a plurality of second guide walls which project from said one narrow wall of the second square waveguide toward each of the openings.

15. (added) A plasma processing apparatus according to claim 7, characterized by further comprising said plurality of oscillators.

16. (added) A plasma processing apparatus according to claim 7, characterized by further comprising a plurality of microwave supply devices including said antenna assembly and said distributor.

17. (added) A plasma processing apparatus according to claim 16, characterized in that in two of the microwave supply devices, the other end of one of said radiation waveguides opposes that of the other of said radiation waveguides, and said oscillators interpose said radiation waveguides and are located on opposite sides.